

Brachiopods collected by BENTHEDI-Cruise in the Mozambique Channel

by O. N. ZEZINA

Abstract. — Fourteen valid species are identified from 31 BENTHEDI stations (March-April 1977). One of the species *Argyrotheca angulata* is a new one. *Eucalathis murrayi*, *E. rugosa*, *Dallithyris stearnsi*, *Argyrotheca australis*, known before as Westpacific species, now must be considered Indo-Westpacific. Some deep-sea species (*Pelagodiscus atlanticus*, *Chlidonophora chuni*, *Phaneropora galathea*) have the same rising of their upper boundary in the west part of the Indian Ocean, as it was known before for the low latitudes in the Western Pacific and in the Western Atlantic.

Résumé. — Quatorze espèces ont été identifiées dans 31 stations de la campagne BENTHEDI (mars-avril 1977). Une seule espèce est nouvelle : *Argyrotheca angulata*. *Eucalathis murrayi*, *E. rugosa*, *Dallithyris stearnsi*, *Argyrotheca australis*, considérées jusqu'à présent comme des espèces du Pacifique occidental, ont une distribution Indo-Ouest pacifique. Quelques espèces profondes (*Pelagodiscus atlanticus*, *Chlidonophora chuni*, *Phaneropora galathea*) présentent toutes une limite bathymétrique supérieure moins profonde dans l'ouest de l'océan Indien que dans l'est comme il était reconnu auparavant pour les basses latitudes dans les océans Pacifique et Atlantique.

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INTRODUCTION

The « BENTHEDI » collection was sampled during March and April 1977 under the leadership of B. A. THOMASSIN (Station Marine d'Endoume, Marseille) in the northern part of the Mozambique Channel (near the Mayotta I., the Glorieuse Is.; on the Zelee Bank and on the Leven Bank) and in its middle part (near the Europa I.) by the French oceanographic research vessel "N/O Suroît" (see table 1 and fig. 1).

Brachiopod samples were sent to me for the identification in April 1981 by C. C. EMIG (Station Marine d'Endoume, Marseille), who have got them from the head of the Centre National de Tri d'Océanographie Biologique (CENTOB, Brest). I am thankful to my French colleagues, who allowed my work on this very interesting collection.

TABLE I. — Brachiopod records (number of individuals per station and per species) during the BENTHEDI expedition.

LOCALITIES	STATIONS	METHODS OF COLLECTING	DEPTH (in m)	<i>Lingula</i> sp.	<i>Pelagodiscus atlanticus</i>	<i>Basilola arnaudi</i>	<i>Chlidonophora chuni</i>	<i>Eucalathis rugosa</i>	<i>Eucalathis costellata</i>	<i>Eucalathis murrayi</i>	<i>Eucalathis</i> sp.	<i>Dallithyris stearnsi</i>	<i>Dallithyris</i> sp.	<i>Gryphus</i> vel <i>Dallithyris</i> sp.	<i>Argyrotheca angulata</i>	<i>Argyrotheca australis</i>	
Mayotte I.	18	S	15	2d													
	32	R + S	15-20	1d													
	36	S	30														
	38	DR	200-500														
	49	F	300-450					2d									
	72	DS	300-350														
	68	F	400-460											2b			
	71	DS	450					1d	2d	1d					1b		
	42	DS	400-520		1d												
	61	F	475-500										2b				
	48	DS	500										1b				
	54	F	530														
	58	DS	700				1d										
	28	DR	705									1w					
	59	F	700-800					1d									
	64	DS	770-860					1d									
	40	DR	1300-1480														
	31	CH	1800										1w				
	Glorieuses I.	08	DR	250			6wb				1d						1d
		120	DS	335-390													
94		DS	450														
104		DR	330-550							2d							
06		DR	450-500								1d				1d		
93		DS	480-550													1d	
90		CH	3700			1b											
87		CH	3716			1w2b											
Leven Bank	01	R	42														
	05	DR	35-150														
	04	DR	200-250							2d							
Zelee Bank	109	R	50														
Europa I.	PV15	R															
TOTAL OF INDIVIDUALS :				3	5	6	3	3	2	6	3	3	2	1	1	2	

S : diver's collecting with a landing net; R : diver's manual collecting; F : collecting with a mop; DS : dredging on soft sediment; DR : dredging on rocks; CH : trawling; d : dried, w : whole, b : broken specimen.

TABLE I (continuation).

LOCALITIES	STATIONS	METHODS OF COLLECTING	DEPTH (in m)	Megathyrididae gen. sp.	Kraussinidae gen. sp.	<i>Megerlina pisum</i>	<i>Megerlina gigantea</i>	<i>Platida anomitoides</i>	<i>Phaneropora galathea</i>	Terebratellidae gen. sp.	<i>Lacazella mauritiana</i>	TOTAL OF INDIVIDUALS
Mayotte I.	18	S	15									2
	32	R + S	15-20									1
	36	S	30			1d						1
	38	DR	200-500					6w			1b	7
	49	F	300-450				1w					3
	72	DS	300-350					4w				4
	68	F	400-460									2
	71	DS	450						3w			8
	42	DS	400-520						5w			6
	61	F	475-500									2
	48	DS	500									1
	54	F	530									1
	58	DS	700					1b				1
	28	DR	705							1w		2
	59	F	700-800									1
	64	DS	770-860									1
	40	DR	1300-1480							1d		1b
31	CH	1800										1
Glorieuses I.	08	DR	250									8
	120	DS	335-390						3d			3
	94	DS	450						1w			1
	104	DR	330-550									2
	06	DR	450-500	2b	1d							5
	93	DS	480-550									1
	90	CH	3700									1
87	CH	3716									3	
Leven Bank	01	R	42			1d					1b	2
	05	DR	35-150			22wd					2w	24
	04	DR	200-250									2
Zelee Bank	109	R	50			1w					1	
Europa I.	PV15	R									24wdb	24
TOTAL OF INDIVIDUALS :				2	1	25	1	1	23	1	29	123

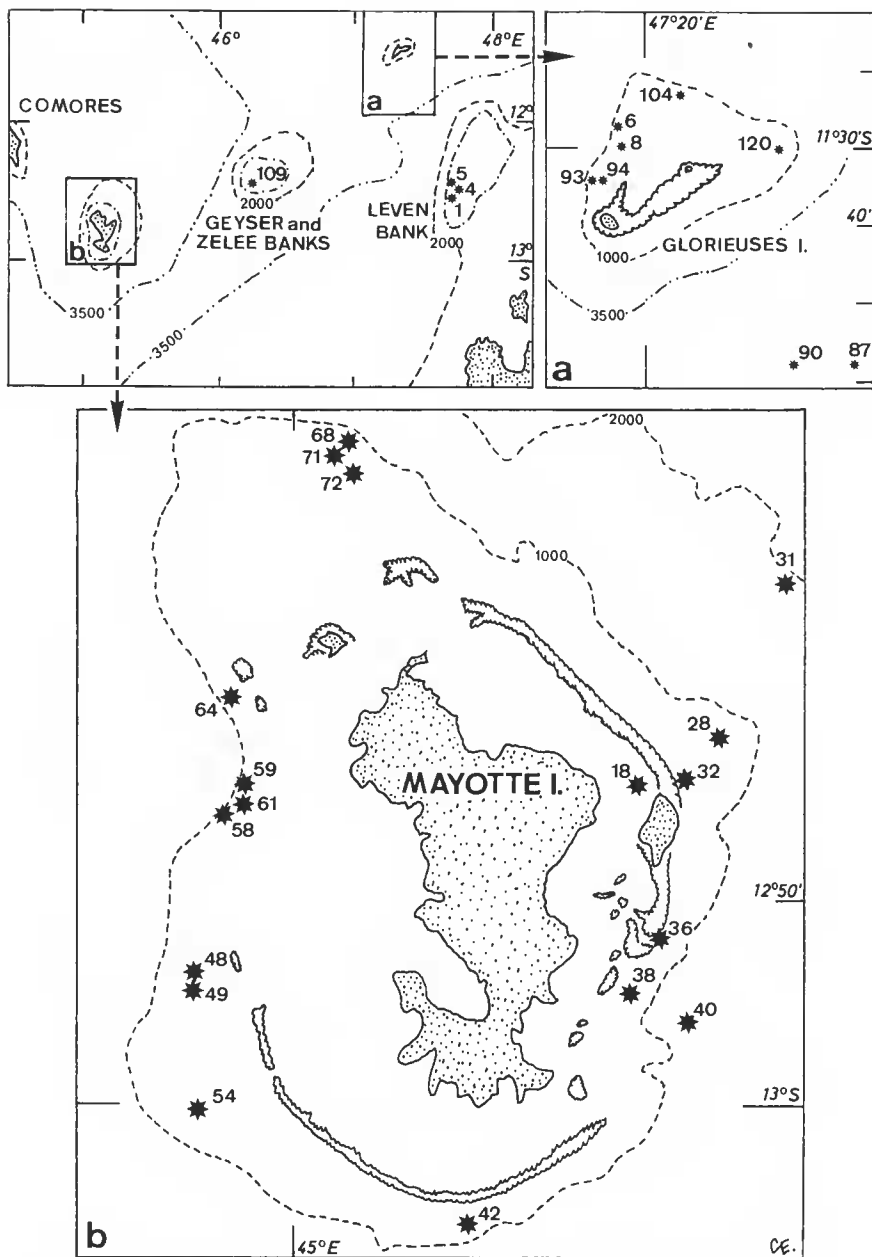


FIG. 1. — Locations of the BENTHEDI stations where brachiopods were collected.

SYSTEMATICAL PART

Data on every species of Brachiopoda, collected by BENTHEDI expedition, are following. The Brachiopoda collection is preserved in the Muséum national d'Histoire naturelle de Paris.

1. *Lingula* sp.

The specimens are young and have no specific indications yet. Two specimens from BENT. 18 are translucent and colourless, but the specimen from BENT. 32 has a greenish shell. Every of the collected specimens possess a rounded frontal edge.

Dimensions of the shells (mm)

N of specimen	1	2	3
Length of the whole shell	1.6	3.0	6.1
Length of the larval shell (protegulum)	1.3	0.9	1.9

It is expected to meet in the investigated regions *L. anatina* Lamarck, 1801, which has been recorded in the western part of the Indian Ocean by MUIR-WOOD (1959) and EMIG (1982).

2. *Pelagodiscus atlanticus* (King, 1868)

There is a series of different aged specimens. The smallest one (BENT. 90) is a broken shell (1.1 mm in length) with small pieces of soft parts, torn off from substrate. The largest specimen, from the BENT. 87 has 4.5 mm in length. The shell of *P. atlanticus* which is usually almost smooth at the BENT. 42 imitates the sculpture of the mollusc shell.

3. *Basiliola arnaudi* Cooper, 1981

Adult specimens characterize with asymetry of shells : the middle uniplicate fold is not central, but moved aside to form sigmoidal frontal commissure figured by DALL (1895, pl. 31 : figs. 1-4) for *B. beecheri*. Young specimens possess the disjunct deltidial plates and the open foramens. Every specimen has a strong sessile pedicle collar. Apical edges of falcifer crura are decorated by festoons. This species was known before the BENTHEDI collection from the depth of 380 m at the Samper Bank (SE of the Madagascar I.) (COOPER, 1981).

4. *Chlidonophora chuni* Blochmann, 1906

BENTHEDI specimens are the addition to the most shallow samples of this species, known before from the depth of 740-3490 m. Previously, a rare specimen with very short

pedicle, similar to pedicle of *C. incerta* was collected off Dar-es-Salam (740 m) (ZEZINA, 1981b). A specimen from BENT. 64 has a long branched pedicle, usual for *C. chuni*.

5. *Eucalathis rugosa* Cooper, 1973

The species was described at first from the depth of 192 m off Philippine Is. (COOPER, 1973a) and later identified by ZEZINA (1981b) in the collection from the southern part of the Emperor Seamounts (Milwaukee Smt., depth 370 m) and from the slope of Tasmania (755 m). The occurrence of *E. rugosa* in the BENTHEDI collection is the first record of the species in the Indian Ocean. *E. rugosa* is similar to the Atlantic species *E. trigona* (Jeffreys, 1878) in number of costae and in the character of their ornament, but the knowledge of *E. trigona* does not allow to consider these two species identical or different.

6. *Eucalathis costellata* Cooper, 1981

The species has been described by COOPER (1981) on the Walters and the Samper Banks, SE of the Madagascar (380-635 m). Its shell is falcicostate with the highest middle costa in each triade. *E. costellata* is similar to *E. fasciculata* Cooper, 1973b, which was described on the single empty shell in the SE part of the Mozambique Channel (1080-1280 m) and which differs from *E. costellata* by smooth parts of a shell in the middle and posteriorly. Perhaps these features are individual variances, or the result of obliterating, and now it is difficult to formulate specific differences between these two species, described by the same author. Both species from the Mozambique Channel resemble the Atlantic species *E. tuberosa* Jeffreys, 1878, which needs to be described with more details. It is necessary to point out especially if *E. tuberosa* possesses a fascicostate shell. There are specimens of *E. tuberosa* collected in the Reykjanes Ridge (1785 m) with triades similar to those of *E. costellata* and of *E. tuberosa*. A similar fasciculation of *E. tuberosa* is figured by FISCHER et OEHLERT (1891). Some empty shells of *E. fasciculata* or *E. costellata* were collected on the slope of the Lord Howe Rise (1500 m; Taman Sea Basin). These data allow to purpose the distribution of the species if not around the World (from 380 to 2736 m as *E. tuberosa*) then in the Indo-Westpacific (from 380 to 1500 m).

7. *Eucalathis murrayi* (Davidson, 1878)

The shells of BENTHEDI collection possess 10 simple smooth costa with rounded ridges on the brachial valve and 9 ones on the pedicle valve, which are characteristic for *E. rotundata* described by COOPER (1981) on the Walters Bank (185-360 m). They variate in length (with a maximum of 6 mm) and in shape from round to triangular. There are no diagnostic differences between *E. rotundata* and *E. murrayi*. The COOPER's assertion (1981 : 19) that *E. murrayi* has a more multicostate shell is not quite correct in my opinion because the number of costae is a variable feature for this species, and there is a specimen in the type series of *E. murrayi* (specimen N 1199 ZB, British Museum nat. Hist.) which possesses only 8 costae on the pedicle

valve. This allow to consider *E. rotundata* as a subspecies or ecological modification of the polymorphal species *E. murrayi* which has an Indo-Westpacific distribution from the Mozambique Channel to the Southern Pacific Ridge between 250-3374m.

8. *Eucalathis* sp.

The three specimens (shell length 1.0, 1.1 and 1.6mm) are young and indefinite specifically. Some of these specimens could belong to the genus *Bathynanus* Foster, 1974, which possesses juvenile *Eucalathis* features.

9. *Dallithyris stearnsi* (Dall et Pilsbry, 1892)

All specimens are very large and bad preserved. Spiculs in dorsal body wall are not so dense as in japanese specimens (HATAI, 1940, pl. 12, fig. 1) and are more perforated. Specimens of BENTHEDI cruise are similar to *D. murrayi* described by MUIR-WOOD (1959) from the Indian Ocean without comparison with the Westpacific species *D. stearnsi*, known at that time in a different genus *Gryphus* according to THOMSON (1927). Differences between these two species are not clear now and if *D. stearnsi* and *D. murrayi* are synonyms, the species has an Indo-Westpacific distribution, but to be sure it is necessary to have more well-preserved specimens.

Measurements of BENTHEDI specimens (mm)

	BENT.48	BENT.61
Length of brachial valve	44.7	—
Length of pedicle valve	—	40.3
Width of shell	43.3	35.5

10. *Dallithyris* sp.

Material is badly preserved and does not allow to fulfill a specific identification. The empty shell is destroyed, but resembles the previous species. The full young specimen has no lophophore, but the dorsal body wall takes place and possesses the typical large star-shaped spiculs which are well perforated. The broad transverse bands in the loops of both specimens show that they are *Dallithyris* sp. and perhaps they are young specimens of *D. stearnsi*.

11. *Gryphus* sp. vel. *Dallithyris* sp.

As seen from pieces, the specimen was not adult and had about 6.3 mm in length. Brachial loop is rounded with a more broad transverse band than *Xenobrochus* sp. use to have, but I was unable to consider the specimen *Gryphus* sp. or *Dallithyris* sp. Spicules in the dorsal body wall look like a net and are not star-shaped. There are also spicules in proximal parts of

tentacles in front of lophophore lateral lobes. Spicules are accumulated also in the bases of tentacles and their long transverse branches look like a ladder in the body of lophophore lobes. The spicule pattern in the BENTHEDI specimen is similar to that of *Dallithyris* sp., identified by ZEZINA (1981a : 13-14, pl. 3, figs. 5-6) from the Arafura Sea (390 m).

12. *Argyrotheca australis* (Blochmann, 1910)

Known before the BENTHEDI cruise as an Australian endemic, the species can be considered now as Indo-Westpacific.

13. *Argyrotheca angulata* sp. nov.

(Fig. 2)

DIAGNOSIS. — Shell : small, white, widely transverse (length of pedicle valve 2.1 mm, length of brachial valve 1.6 mm, width of shell 3.3 mm). Shell surface : almost smooth, but faintly faceted with two feeble ridges on each half of the valve ventrally and dorsally, middle ridges being moved aside (the middle ridges are stronger than the lateral ones). Tall area : inclined 45° to the plane of the shell, striated transversely. Deltoidal plates : narrow, triangular, stretched out along the sides of rectangular hypothyrid open foramen which does not reach the umbo of pedicle valve. Pedicle collar : horizontal, flat and wide, grown together with the septum in its posterior half. Pedicle : short and flat, its attaching surface forming a brush of short filaments. No crura ; descending branches of brachial loop attached posteriorly to the front of socket ridges and anteriorly to the back surface of pyramid-shaped septum ; posterior part of the septum near the umbo forms a cavity for a brood pouch. Lophophore : schizolophous.

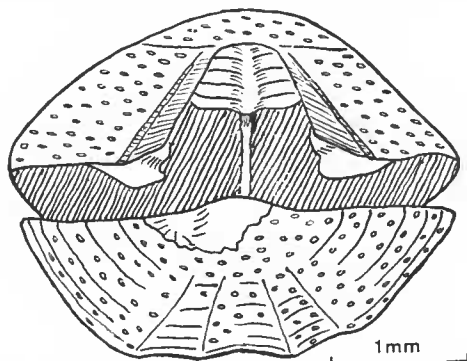


FIG. 2. — *Argyrotheca angulata* sp. nov. Shell of the holotype : dorsal view of the brachial (low) and the peduncular (upper) valves.

HOLOTYPE : BENTHEDI BENT. 06 DR off Glorieuse Is., depth 500-460 m, I dried specimen with some pieces of lophophore and pedicle.

COMPARISONS. — The new species differs other *Argyrotheca* species inhabiting the neighbouring regions of the Indian and the Pacific Oceans by its very broad shell : the width

makes 157 % of the length in *A. angulata*; 106-120 % in *A. australis* (Blochmann, 1910); 82 % in *A. mayi* Blochmann, 1914; 102 % in *A. jacksoni* Cooper, 1973*b*; 99-104 % in *A. somaliensis* Cooper, 1973*b*. The new species differs also by its weak radial sculpture (two middle stronger ridges and two side feeble ridges on every valve), compared to the smooth shell of *A. mayi* and the well-marked multicostate shells of the other species of this genus. All the species, known from the Indian and the Pacific Oceans, are forming a range from smooth to the most costellate form : *A. mayi* — *A. angulata* — *A. australis* — *A. jacksoni* — *A. somaliensis*. If it is proved that the costellation depends on some ecological factors or is connected with the growth rate, some of the species may be considered as synonyms of *A. australis*.

14. MEGATHYRIDIDAE gen. sp. indet.

From BENT. 06, some fragments of two shells, with pieces of muscles and lophophores and two pedicles attached to the pieces of dead corals were picked out from the glass fragments. Lophophore shape, width of area and thickness of the shells allow to guess, that all these pieces are related to some megathyridid, possibly to *Argyrotheca* sp.

15. KRAUSSINIDAE gen. sp. aff. *Pumilus* sp.

This is a small, round, yellow, punctate shell (length of pedicle valve 1.1 mm, length of brachial valve 1.1 mm, width of shell 1.0 mm). Lophophore is trocholophous (with centripetal filaments), full of spicules, without brachial supports. Foramen is mesothyrid, open, without deltidial plates. Dental plates are feeble. Four eggs were found in the cavity and on the lophophore, that is the evidence of adult specimen. It is not identical to any species known before, but this single very small specimen is too poor material to describe a new species.

16. *Megerlina pisum* (Lamarck, 1819)

The species was described at first from off Mauritius I. (Mascarene Is.) and has been recorded in the Indian Ocean off the Africa shores. BENTHEDI specimens are smaller than the South African specimens : the largest (BENT. 36) is 5.8 mm in length and 6.5 mm in width. The sulcate fold forms a semicircular invagination at the anterior edge of the largest specimens. *M. pisum* from BENTHEDI collection and *M. natalensis*, a synonym of the former species, from the "Vema" collection (COOPER, 1973*c* : 22, pl. 8, figs. 25-33) have an intermediate position between the genera *Kraussina* and *Megerlina*, because instead of the plates of the descending branches, they possess the curves of ascending branches, that can be considered as a feature of a separate genus.

17. *Megerlina gigantea* (Deshayes, 1863)

The single collected specimen is adult (length of the pedicle valve : 9.7 mm ; length of the brachial one : 8.1 mm ; width of the shell : 11.3 mm). The pedicle valve is covered with low

nodules, which are organized in radial rows only at the posterior part of the valve. The brachial valve is slightly convex and has a smooth outer surface. This species could not be referred neither to the genus *Megerlia* as proposed by COOPER (1981 : 27) nor to the genus *Pantellaria* as I suggested previously (ZEZINA, 1985 : 204), because the species (as it is established on the BENTHEDI specimen) has no crura at all, the descending branches forming two curved plates, not attached posteriorly to the free and even cardinal edge.

The opinion that *Megerlia* (= *Muhlfeldtia*) *echinata* Fischer et Oehlert, 1891 is a synonym of *M. gigantea* is doubtful, because well known *M. echinata* possesses crura and well developed descending branches. The broken specimen of *Megerlina* sp. (COOPER, 1973b : 19, pl. 8, fig. 11) collected off the Mozambique coast (132 m) is supposed to be *M. gigantea*. This conjecture is in accordance with the notion that *M. gigantea* is endemic of the western part of the Indian Ocean, and distinct from *M. echinata* which is an Atlantic species.

18. *Platidia anomioides* (Scacchi et Philippi, 1844)

A fragile white shell (2.5 mm long, 3.0 mm wide) was broken. It is similar to Mediterranean specimens in number of pores (169 punctae per square mm on the brachial valve, and 255 punctae at pedicle valve), in the large lophophore and in the short socket ridges. But the BENTHEDI specimen has a white shell like *P. marionensis*. A specimen of *Platidia* sampled by the RV "Academician Kurchatov" in the northern part of the Mozambique Ridge (1500 m) has a yellowish and more punctate shell (196 punctae per square mm at the brachial valve and 306 punctae at the pedicle valve). Thus, perhaps *P. anomioides* is a variable eurybiotic species with a wide range of distribution along the vertical scale in the warm and temperate water of the Atlantic Ocean, Mediterranean Sea and the Indian Ocean.

19. *Phaneropora galatheae* Zezina, 1981

BENTHEDI collection enlarges the knowledge of the species distribution from the coasts of the Australia and the New Zealand (390-775 m, and empty shells 240-1640 m) (ZEZINA, 1981a, 1985) to the Indo-Westpacific (from 335 to 1480 m). BENTHEDI specimens have the same morphological variation of the beak ridges as the West Pacific specimens. Most of the specimens have the beak ridges covered with tubercula. Even the youngest specimens (0.75 mm in length in BENT. 71; 0.80 mm in BENT. 72; 1.3 mm in BENT. 42) have the well distinct tubercula. Nevertheless, two specimens (1.6 to 2.7 mm long) among the five at BENT. 42 have no tubercula on the beak ridges, as well as the three specimens (maximum length 2.3 mm) at BENT. 120. In these specimens the presence or absence of tubercula do not depend neither from the size of shell nor from the depth habitat.

20. TEREBRATELLIDAE gen. sp. aff. *Aerothyris* sp. juv.

DESCRIPTION. — Small round white smooth punctate shell (length of pedicle valve 5.2 mm, length of brachial valve 4.6 mm, width of shell 4.8 mm). No dental plates; the

mesothyrid foramen open; the triangular deltidial plates very small. Cardinal process absent; inner hinge plates elevated on the sides, becoming one with the tall socket ridges, and attached in the middle to the septum, which extends $2/3$ of the brachial valve. Thin crura begin from the base of the socket ridges. Brachial septum, elevated in the posterior $1/3$ of the valve, touches the mantle of the pedicle valve with its straight top and carries the torns at the anterior edge. Ascending branches of the brachidium form an empty tube at the posterior edge of the highest part of the septum; frontal end of the tube wider than the back end. Lophophore early plectolophous without median lobe and with lateral lobes well developed. No spicula in the soft parts.

REMARKS. — The specimen, collected by BENTHEDI expedition, is similar to *Aerothyris* sp. (COOPER, 1981 : 59, pl. 4, figs. 4-6), collected by the "N/O Marion-Dufresne" (MD 8) off the Crozet Is. (1500 m), but the BENTHEDI specimen is younger as it is seen from the shell size and from the stage of development in brachidium and deltidial plates.

21. *Lacazella mauritiana* Dall, 1920

BENTHEDI collection gave the sufficiently new data for the species, known before only from the Mauritius I. (Mascarene Is.) on the single specimen which is the holotype (N 173593 USNM). BENTHEDI specimens allow to study some morphological variations of the species. The hooks of hemispondilium are the terminal stage of its development : in every specimen the hemispondilium is different, forming plates of various length with various shape of the apical border. Some living specimens of *L. mauritiana* inhabiting the surface of living coral colony were covered by the growing layer of this colony. The empty shells from BENT. 38 and BENT. 40 are found at the unusual depth for the thecid brachiopods. These shells are cemented to small pieces of substrate, and evidently they have been carried down to the depth from the shallow water.

CONCLUSIONS

Fourteen valid species are identified from the 31 BENTHEDI stations where Brachiopoda have been collected. One of the species *Argyrotheca angulata* (Megathyrididae) is described as a new species. Seven species from the genera *Lingula*, *Eucalathis*, *Dallithyris* and from uncertain genera of the families Terebratulidae, Megathyrididae, Kraussinidae, Terebratellidae could not be identified because the specimens are young with the underdeveloped morphological features.

Beside the species, known before the western part of the Indian Ocean (mostly from the shelves of the Reunion I. and the Mauritius I.), some other species which were recorded before from the western part of the Pacific Ocean only (i. e. *Eucalathis murrayi*, *E. rugosa*, *Dallithyris stearnsi*, *Argyrotheca australis*) are found now in the Mozambique Channel. Therefore they have the Indo-Westpacific distribution.

As it is evident from the BENTHEDI collection, some deep-sea species (*Pelagodiscus*

atlanticus, *Chlidonophora chuni*, *Phaneropora galathea*) lift their upper bathymetric range in the West of the Indian Ocean, like deep-sea species use to do (fig. 3) in the Western Pacific and of the Western Atlantic (ZEZINA, 1965, 1981a, 1985).

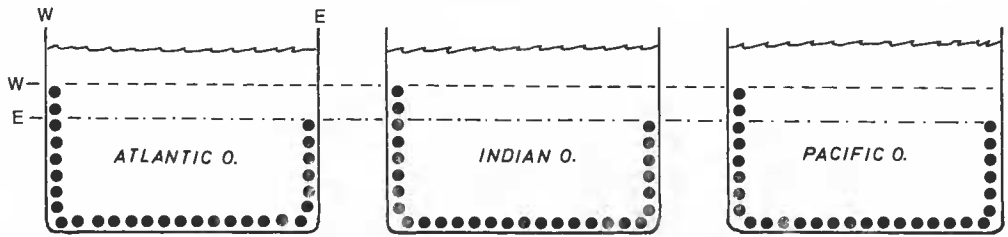


FIG. 3. — Asymmetry of the deep-sea brachiopod distribution at the low latitudes. W : upper boundaries (300-500 m) in the western parts of the Oceans ; E : upper boundaries (1500-2000 m) in the eastern parts of the oceans.

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